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NAKIAIDO, MARMELSTIEN, MURRAY & ORAM
METRO. SQUARE
655 15TH ST, N.W.
SUITE 330-G ST. LOBBY
WASH., D.C. 20005-5701

GOLDREAU, EXAMINER

ART UNIT PAPER NUMBER

1104

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DATE MAILED: 08/25/93

This is a communication from the examiner in charge of your application.
COMMISSIONER OF PATENTS AND TRADEMARKS

☒ This application has been examined ☐ Responsive to communication filed on _____ ☐ This action is made final.

A shortened statutory period for response to this action is set to expire 3 month(s), _____ days from the date of this letter.
Failure to respond within the period for response will cause the application to become abandoned. 35 U.S.C. 133

Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

- | | |
|---|---|
| 1. <input type="checkbox"/> Notice of References Cited by Examiner, PTO-892. | 2. <input type="checkbox"/> Notice of Draftsman's Patent Drawing Review, PTO-948. |
| 3. <input checked="" type="checkbox"/> Notice of Art Cited by Applicant, PTO-1449. | 4. <input type="checkbox"/> Notice of Informal Patent Application, PTO-152. |
| 5. <input type="checkbox"/> Information on How to Effect Drawing Changes, PTO-1474. | 6. <input type="checkbox"/> _____ |

Part II SUMMARY OF ACTION

1. ☒ Claims 1-22 are pending in the application.
Of the above, claims _____ are withdrawn from consideration.
2. ☐ Claims _____ have been cancelled.
3. ☐ Claims _____ are allowed.
4. ☒ Claims 1-22 are rejected.
5. ☐ Claims _____ are objected to.
6. ☐ Claims _____ are subject to restriction or election requirement.
7. ☐ This application has been filed with informal drawings under 37 C.F.R. 1.85 which are acceptable for examination purposes.
8. ☐ Formal drawings are required in response to this Office action.
9. ☐ The corrected or substitute drawings have been received on _____. Under 37 C.F.R. 1.84 these drawings are ☐ acceptable; ☐ not acceptable (see explanation or Notice of Draftsman's Patent Drawing Review, PTO-948).
10. ☐ The proposed additional or substitute sheet(s) of drawings, filed on _____, has (have) been ☐ approved by the examiner; ☐ disapproved by the examiner (see explanation).
11. ☐ The proposed drawing correction, filed _____, has been ☐ approved; ☐ disapproved (see explanation).
12. ☒ Acknowledgement is made of the claim for priority under 35 U.S.C. 119. The certified copy has ☐ been received ☒ not been received
☐ been filed in parent application, serial no. _____; filed on _____.
Official copy of Japanese patent applicant not yet received
13. ☐ Since this application appears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11; 453 O.G. 213.
14. ☐ Other

EXAMINER'S ACTION

Rev. 2/93)

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15. Claims 3, 7-13 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

- The use of the phrase "containing" is non-conventional legal language, and is vague, and indefinite. Applicant should replace this language with more conventional legal language such as "consisting of, consisting essentially of, or comprising".

16. The following is a quotation of 35 U.S.C. § 103 which forms the basis for all obviousness rejections set forth in this Office action:

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

17. Claims 1-6 are rejected under 35 U.S.C. § 103 as being unpatentable over Tateiwa further in view of Shinagawa et al.

Tateiwa discloses a process for patterning an Al wiring layer on a semiconductor substrate comprised of the following steps:

- First, an Al layer sandwiched between a patterned resist layer and a semiconductor substrate is etched in a plasma comprised of Cl_2 in a first chamber;
- Second, the resist mask is ashed in a plasma comprised of O_2 in a second chamber adjacent the first chamber; and
- Third, the substrate is post-treated to remove corrosive Cl residues left from the dry etch with a plasma in a third chamber adjacent to the second chamber. This is discussed, and shown in the abstract.

Tateiwa fails, however, to disclose the following aspects of applicant's claimed invention:

- the specific use of a plasma comprised of O_2 and H_2O to ash the resist layer in which only neutral species of the plasma contact the substrate so as to reduce the total amount of radiation damage done to the substrate;
- the specific removal of corrosive Cl_2 residues left from the etch step with the Cl_2 using the ashing step;

- the specific use of a barrier layer between the Al metal film and the semiconductor substrate; and
- the specific ashing temperatures claimed by the applicant.

Shinagawa et al. teach that it is desirable to use the neutral species from a plasma comprised of H_2O , and O_2 to ash a resist layer off of a substrate in order to achieve as high etch rate as possible while still maintaining as low level of radiation damage to the substrate. They further teach that it is desirable to ash the resist layer at $180^\circ C$. This is shown in figure 7; and discussed in columns 4, 7, and 9.

It would have been obvious to one skilled in the art to employ the O_2 - H_2O resist ash step taught by Shinagawa et al. in place of the O_2 ash step taught by Tateiwa in the method taught by Tateiwa based on the following. First, this simply represents an alternative, and ^{at least equivalent means for conducting} the ashing step taught by Tateiwa et al. Second, Shinagawa et. al. teach the desirability of using a plasma comprised of H_2O and O_2 to ash a resist layer both in terms of the through put of the process, and the amount of radiation damage done to the substrate.

It would have been prima facie obvious to employ any of a variety of process temperatures to ash the resist layer in the process taught above including those claimed by the applicant. These are all well known variables in the plasma etching art which are known to effect both the rate and quality of the plasma etching process. Further, the selection of particular values for these variables would simply involve routine experimentation and would not necessitate any undo experimentation which would be indicative of a showing of unexpected results. Further, Shinagawa et al. provide a suggestion to operate in applicant's claimed temperature range when ashing resist in an O_2 - H_2O based plasma.

It would have been obvious to one skilled in the art to employ a barrier layer between the Al wiring layer and the semiconductor device in order to prevent the specific interaction of the Al with the semiconductor wafer via a diffusion mechanism since the use of such barrier layers are conventional or at least well known and would therefore not be unexpected to one skilled in the art.

18. Claims 11-19 are rejected under 35 U.S.C. § 103 as being unpatentable over Fukuyama et al. further in view of Shinagawa et al.

Fukuyama et al. disclose a process for patterning an Al layer on a semiconductor substrate comprising the following step:

- First, an Al layer sandwiched between a patterned resist mask and an interlayer dielectric barrier layer on the semiconductor wafer is dry etched in a plasma comprised of Cl_2 ;
- Second, the resist layer is ashed in a plasma comprised of O_2 ; and

Third the dry etched sample is posttreated in a plasma of a H_2 - containing gas to remove corrosive Cl-residues from the etched structure using the H species in the plasma. This is discussed in columns 1-18. Fukuyama et al., fail, however, to disclose the following aspects of applicant's claimed invention:

- the use of a 3 step process in which the 3rd step comprises a posttreatment with a plasma comprised of H_2O to remove corrosive Cl- residues, and the second step comprises ashing the resist layer with a neutral plasma comprised of O_2 claimed by the applicant;

- the specific use of different apparatus to conduct the second, and third process steps; and
- the specific use of a downflow type apparatus to conduct the third step.

It would have been obvious to one skilled in the art to replace the H_2 plasma posttreatment used to remove corrosive Cl-residues in the process taught by Fukuyama et al. with a plasma comprised of H_2O based on the following. First, any of a variety of H-denoting plasma including those comprised of H_2O would be capable of providing the H-based plasma needed for the posttreatment of corrosive Cl residues based on the teachings of Fukuyama et al. Second H_2O is a well known H-donating gas commonly used in the plasma art whose use as a H-source would not be unexpected by those skilled in the art.

It would have been prima facie obvious to employ any of a variety of ashing temperatures including those claimed by the applicant. These are all well known variables in the plasma etching art which are known to effect both the rate and quality of the plasma etching process. Further, the selection of particular values for these variables would simply involve

routine experimentation and would not necessitate any undo experimentation which would be indicative of a showing of unexpected results. Further, Shinagawa et al. provide a suggestion to conduct the ashing step in applicant's claimed range.

It would have been obvious to one skilled in the art to conduct the second and third process steps in the process taught above in separate apparatus instead of the single apparatus taught based on the following. First, this would have been an obvious way to increase the through-put of the process since it would allow both the ashing, and posttreatment steps to occur in separate process chambers at the same time rather than performing both processes in a single process chamber. This would further have the obvious advantage of allowing each chamber to be dedicated to a single process facilitating the optimization of each process by being able to permanently adjust each chamber to settings ideal for the targeted process being conducted at the time.

It would have been obvious to one skilled in the art to employ any of a variety of well known types of plasma ashers to

ash the resist layer in the process taught above including "down-flow" type reactors.

19. Applicant's arguments with respect to claims 1-22 have been considered but are deemed to be moot in view of the new grounds of rejection.

20. Claims 20-22 are rejected under 35 U.S.C. § 103 as being unpatentable by Tateiwa.

Tateiwa is discussed in paragraph 17 above. Tateiwa fails, however, to disclose the following aspects of applicant's claimed invention:

- the specific use of vacuum load-lock chambers for loading, and unloading parts into the each process chamber; and

- the specific usage of the posttreatment gas claimed by the applicant.

It would have been obvious to one skilled in the art to employ vacuum load-lock chambers between each of the separate process vessels disclosed in the paragraph above in order to facilitate the loading and unloading of parts into each chamber in order to facilitate the reduction of cross contamination of the separate processes.

Furthermore, it is obvious to one skilled in the art that the configuration of the substrate worked upon by the apparatus claimed in this invention is not patentable in view of In re Young (25 U.S.P.Q. 69, 71 (CCPA 1935) and In re Rishoi (94 U.S.P.Q. 71, 73 (CCPA 1952)). The Court of Customs and Patent Appeals stated in In re Young that inclusion of material worked upon by a machine as element in claim may not lend patentability, since claim is not otherwise allowable. Similarly, the Court of Customs and Patent Appeals stated in In re Rishoi that there is no patentable combination between a device and the material upon which it works.

Thus, applicant recitation of the processes gases used does not patentably distinguish their claims over the prior art of record.

21. The Examiner has not yet received an official copy of applicant's Japanese priority document. Applicant must submit this document along with perfecting their claim to priority by providing an sworn, notarized English translation of their foreign priority document.

22. This action will not be made final due to the new grounds of rejection.

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23. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner George Goudreau whose telephone number is (703) 308-1915.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 308-0661.

George A. Goudreau

G.Goudreau:mm
August 24, 1993

George A. Goudreau
Examiner
AU. 1104